DESIGN REPORT
FOR THE
LAKE ENHANCEMENT PROGRAM
AT PRIDES CREEK LAKE

PREPARED FOR:

PRIDES CREEK CONSERVANCY DISTRICT BOARD
715 S. 9TH STREET
PETERSBURG, IN 47567

PREPARED BY:

DONAN ENGINEERING CO., INC.
R.R. 3, BOX 40H
JASPER, INDIANA 47546

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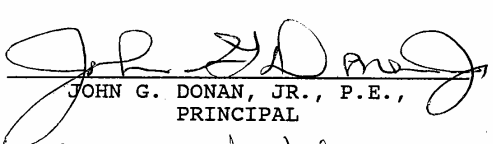

JOHN G. DONAN, JR., P.E.,
PRINCIPAL

DARREN L. HELMS, PROJECT ENGINEER

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EXECUTIVE SUMMARY

A lake enhancement design study of Prides Creek Lake near Petersburg, Indiana was made to find a solution for the sedimentation and nutrient problem identified in the Feasibility Study for the Lake Enhancement Program of Prides Creek Lake.

As was pointed out in the feasibility study, the utility of the lake has been decreased due to sedimentation and excessive aquatic weed growth. This design study recommends that sediment removal structures be constructed in two of the inlets to Prides Creek Lake. The inlets were selected for construction because they were identified as the major contributors in the feasibility study.

Donan Engineering recommends that a sediment basin be constructed in one inlet and a sediment basin/wetland in the other. These structures have been designed to remove silt and larger suspended particulates. Along with the removal of suspended particulates, nutrients associated with the particulates will likewise be removed.

The estimated cost for construction of the structures and associated items is $99,789.58. The estimated maintenance cost per year is $1,500.00

1.0 INTRODUCTION

Prides Creek is a ninety (90) acre, multi-purpose reservoir located south of Petersburg, Indiana (Figure 1). The lake is located entirely within Prides Creek Park which is a public recreation facility administered by the Prides Creek Conservancy District. The Park provides shore fishing as well as a concrete boat ramp, a public beach and swimming area, and camping facilities.

A Lake Enhancement Feasibility Study was conducted to evaluate existing conditions affecting Prides Creek Lake. The specific areas of concern were the sedimentation of the inlets, the aquatic weed problem which is affecting shore fishing and the boat launch area, and the nutrient loading. The study encompassed these concerns and presented conclusions and recommendations. The feasibility study recommendations included maintaining the current aquatic weed control program, implementing water and sediment control basins (WASCOBs) in Watersheds PCR3 and PCR4, and the construction of sediment control structures in the inlets of Watersheds PCR3 and PCR4.

This Lake Enhancement Program Design Report details the design procedures that were used and the recommendations for the construction observation, operation and maintenance of the structures. Recommendations regarding post-construction monitoring of the lake influent are also presented.

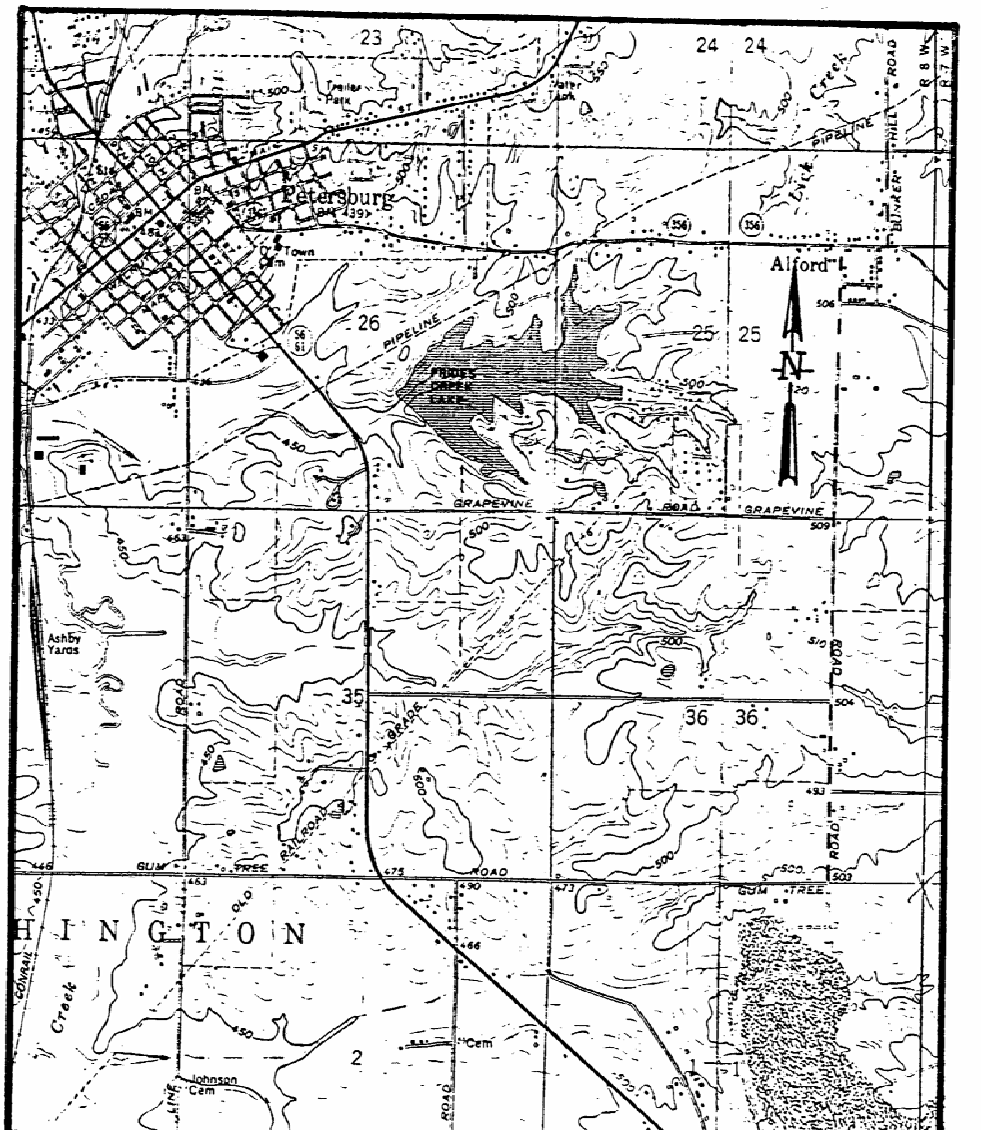

FIGURE 1.

LOCATION MAP

SCALE: 1"=2000'

DONAN ENGINEERING CO., INC.
Rural Route 3 Box 401
Jasper, Indiana 47546

This report should be reviewed in conjunction with the Contract Documents of the Prides Creek Lake Enhancement Project which includes: plan sheets, advertisement for bids, information to bidders, bid and bid bond, agreement, payment bond and performance bond, special conditions, general conditions, and technical specifications.

2.0 GENERAL PROJECT DESCRIPTION

As was addressed in the Feasibility Study for the Lake Enhancement Program of Prides Creek Lake, sedimentation has greatly decreased the utility of certain areas of the lake. A significant volume of sediment has accumulated in two of the seven watershed inlet areas, Watershed Inlets PCR3 and PCR4 (see Appendix A). These inlets were once suitable for such recreational uses as boating and fishing, but are no longer usable due to sedimentation. Our design report will address only Watershed Inlets PCR3 and PCR4 which have been significantly impacted by principal contributors of sedimentation.

To mitigate and control the sedimentation problems in these inlets, a sediment basin and sediment basin/wetland area have been designed to detain runoff produced by storm events, thereby settling a portion of the particulate matter and the associated nutrients.

3.0 OBJECTIVE OF THE DESIGN

The settling of suspended solids from storm runoff is the main focus of the project design. The removal of these particulates will be accomplished by constructing a sediment basin in Inlet PCR3 and a sediment basin/wetland area in Inlet PCR4 (see Appendix A). Along with the settlement of the particulates, a reduction in the associated nutrients is also anticipated. By decreasing the sediment and nutrient loading to the lake, the rate of eutrophication should likewise decrease.

Another objective of the design is to localize the sedimentation and provide for an efficient and effective removal of accumulated sediments in the future. This was achieved by situating the primary sediment traps in areas that are easily accessible to dredging equipment. The designs will also utilize the existing inlet areas as the construction locations.

4.0 HYDROLOGY AND HYDRAULICS

The structures of the project will consist of a sediment basin in Construction Area No. 1 (Inlet PCR3) and a sediment basin/wetland in Construction Area No. 2 (Inlet PCR4).

The SCS Method was used to model the anticipated storm runoff. This method provides data essential to sediment basin design and analysis.

The Universal Soil Loss Equation was used in the analysis to determine the total sediment load entering into the basins.

A 4.60-inch, 10-year, 24-hour storm event was used to determine the runoff and detention design. An existing pipe arch will be utilized as the principal spillway in Construction Area No. 1, and it will safely pass a 5.25-inch, 25-year, 24-hour storm event. The principal spillway in Construction Area No. 2 was also designed to safely pass a 5.25-inch, 25-year, 24-hour storm event. The principal spillways will function as emergency spillways (see Contract Drawings).

The effects of the newly constructed Water and Sediment Control Basins (WASCOBs) in the watersheds were not taken into consideration during analysis. Therefore, the hydrology and sedimentology of the basin designs are conservative.

All channels and ditches to be constructed in this project were designed to safely carry a 25-year, 24-hour storm event. Erosion control measures are used to stabilize the flow lines where the velocities indicate that they are needed.

Watershed PCR3, as shown in Appendix A, contains approximately 87.6 acres of forest, grassland, cropland and residential areas with cropland comprising approximately 25 percent of the acreage. The watershed is calculated to have a runoff of 16.4 acre-feet during a 10-year, 24-hour storm event. The structure to be constructed in this watershed is designed for a 6-hour detention time and a storage of 4.1 acre-feet (see Appendix B).

Watershed PCR4, as shown in Appendix A, contains approximately 50.9 acres of forest, grassland, cropland and residential areas with cropland comprising 33 percent of the acreage. This watershed is anticipated to yield 10.2 acre-feet of runoff during a 10-year, 24-hour storm event. The structure to be constructed in this watershed will actually be a sediment basin/wetland area. It is designed for a 4-hour detention time and storage of 1.7 acre-feet (see Appendix B).

The storage capacity and detention time of both structures was arrived at by utilizing the existing inlet areas and re-shaping them to form a more effective sediment trap for the design storm event. By utilizing the existing inlet areas, the recreational areas will remain at the same locations, and the construction costs will be kept at a minimum.

5.0 STRUCTURES

5.1 Construction Area No. 1

The structure in Construction Area No. 1 will consist of a primary sediment trap with a riprap filter and a storm event detention area. Construction Area No. 1 will also require reconstructing a portion of the existing inlet channel and shaping a diversion ditch east of the area (see Contract Drawings).

A 6-hour detention time was designed to precipitate most of the silt and larger particles from the runoff (see Appendix B). The primary sediment trap was designed to function for ten (10) years under normal sediment loading conditions before dredging would be necessary. Due to the construction of a WASCOB in the watershed, the primary sediment trap should function effectively for a period of time exceeding the design life.

The riprap filter utilized at the down flow end of the primary sediment trap will be effective in removing a portion of the silt and clay particles which remain suspended after flowing through the primary sediment trap. For an extended period of time following construction, the larger openings in the riprap filter will collect sediment. Channels through the riprap will decrease in size providing the riprap filter to become more effective

in the removal of suspended particulates. The design relies on the primary sediment trap to remove a significant portion of the incoming sediment while the riprap filter provides secondary removal of suspended solids.

The storm event detention area will be effective in removing particulates during high flow periods when the flow exceeds the capacity of the primary sediment trap. This area of the structure is shallower than the primary sediment trap and provides for a shorter settlement time. It is anticipated that this portion of the structure will not require dredging as often as the primary sediment trap.

As mentioned previously, the inlet channel into Construction Area No. 1 will be reconstructed to provide a more stable and defined channel for runoff (see Contract Drawings). The existing inlet channel is very unstable due to the highly erodible soils and a small cross-sectional area which produces high flow velocities. The reconstructed channel has been designed for a 25-year, 24-hour storm event with a riprapped bottom to prevent erosion.

A diversion ditch is to be constructed east of Construction Area No. 1. The ditch will provide a flow path for runoff which has been sheet flowing across a park road into a camping area. The existing ditch, which has some diversion effects on the runoff, is severely eroded in some areas. The existing ditch will be reshaped and

lengthened to form a more effective diversion ditch while mitigating the erosion potential. The diversion ditch has been designed to carry runoff from a 25-year, 24-hour storm event and will be lined with erosion control blankets.

The material excavated during the construction of the structure and inlet channel will be placed adjacent to the constructed sediment basin. This material has been evaluated for its engineering properties and is suitable for embankment construction, based on the analyzed samples. The placement of excavated material should occur under optimum moisture conditions to obtain proper compaction and stability.

The placement of the excavated material adjacent to the structure will disturb electric and water utilities at five campsite pads within Prides Creek Park. It will be necessary to replace these utilities following the construction. After considering alternative locations, the placement of the excavated material adjacent to the structure was determined to be prudent.

5.2 Construction Area No. 2

The structure in Construction Area No. 2 will consist of a primary sediment basin, two pools and a shallow wetland area. The wetland area will utilize bars and islands to lengthen the flow path during normal runoff

periods which increases the residence time and provides for increased nutrient removal (see Contract Drawings). This design makes efficient use of the existing inlet area and does not disturb existing recreational areas.

During extremely high flow periods, the area is designed to short-circuit by allowing the storm runoff to flow directly into the lake. By short-circuiting in extremely high flow periods, the area will not suffer as much deterioration as would be expected during such an event should short-circuiting not be provided.

A 4-hour detention time was designed to precipitate most of the silt size and larger particulates from the runoff (see Appendix B). The primary sediment trap was designed to function properly for approximately ten (10) years under normal sediment loading conditions before cleanout may be required. Due to the construction of WASCOBs in the watershed, the life of the primary sediment trap should exceed the design life due to the reduced sediment loading from runoff of certain cropland areas of the watershed. Wetland vegetation will be allowed to develop naturally within the area and will aid in filtering sediment and nutrients from the runoff. The areas along the bars and islands exposed to high flow rates will require riprap for stabilization of the structures.

The design of the structure requires that the existing 36-inch corrugated metal pipe culvert which outlets into

the area be replaced. The existing pipe culvert is submerged in water and does not function properly.

The existing pipe culvert was observed and appears to be in poor condition and in need of replacement.

The design necessitates that the new pipe culvert be raised to provide for the designed runoff storage volume. The 36-inch corrugated metal pipe culvert will be replaced with a 57 inch x 38 inch corrugated metal pipe arch which was sized according to a 5.25 inch, 25-year, 24-hour storm. A pipe arch was used to meet minimum subgrade cover requirements for a culvert (see Contract Drawings).

The excess material excavated to construct the sediment basin/wetland area will be placed adjacent to the structure. The material has been evaluated for its engineering properties and is acceptable for embankment construction based on the analyzed samples. It will be necessary to place all embankment material under optimum moisture conditions to insure stability.

6.0 STABILITY ANALYSIS

Soil samples were collected at both construction areas to determine the composition, classification and engineering properties of the soil to be excavated and utilized during construction (see Contract Drawings). The analyses determined that most of the sediment deposits and the surrounding soil were composed of clay (15 to 32%), silt (66 to 74%), and sand and gravel (2 to 11%) with low liquid limits (see Appendix C). Therefore, the soil can generally be given a Unified Soil Classification of clay with a low liquid limit (CL). This classification was used in the stability analysis.

A stability analysis was conducted for the channel reconstruction in Construction Area No. 1, as well as for the embankments, islands and bars in Construction Area No. 2 (see Contract Drawings). The Limiting Attractive Force Method was used to determine the conditions under which the structures would be stable. The limiting attractive force was determined to be 0.150 pounds per square foot for the soil analyzed.

A portion of the existing inlet channel in Construction Area No. 1 does not meet the stability requirements of the above mentioned analysis. The channel is unstable due to a small cross-sectional area which produces high velocities for an erodible soil. Therefore, the channel will be reconstructed as shown in the Contract Documents. The channel has been designed to reduce erosion by using a slightly larger

cross-sectional area and lining the flowline with riprap. The riprap in the design has been sized to meet stability requirements for the anticipated open channel flow.

The embankments, islands and bars were analyzed in the same manner as the channel. Construction Area No. 1 will not require special stability treatment. The structure has been designed to promote stability under normal flow conditions. Erosion control blankets will be used in critical areas to promote early stability (see Contract Drawings). Under water slopes are generally 2:1 with above water slopes at 3:1.

Construction Area No. 2 will require special stability treatment along the short-circuit flow path. This path will be the major flow channel during extremely high runoff periods. The flow velocity indicates that riprap is required in the path to provide for a stable channel. The remainder of Construction Area No. 2 will not need special stability treatment, but we recommend that most areas be covered with erosion control blankets to promote initial stability (see Contract Drawings).

7.0 OPERATION AND MAINTENANCE

7.1 Operation and Maintenance Considerations

The removal of accumulated sediment from the structures was the predominant operation and maintenance consideration affecting the design. It is necessary to utilize a layout in which the structures will function effectively with existing topography to reduce maintenance costs. Primary sediment traps and other areas which will accumulate sediment are located at accessible areas in both structures to aid in sediment removal.

Other considerations were to design both structures in a manner which would not be susceptible to deterioration caused by storm events. This concept was utilized namely in the design of Construction Area No. 2 concerning the short-circuit flow path, but was implemented in both designs by using erosion control blankets and riprap in critical erosional areas. These measures were incorporated into the design to minimize erosion and reduce repair and maintenance of the structures.

7.2 Maintenance Plan

Based on the designs, the structures should function for ten (10) years without comprehensive maintenance. Minor maintenance may be necessary following severe storm events to repair areas that exhibit erosion damage.

Minor maintenance to the structures will include repairing areas that have been eroded by replacing soil, placing riprap and erosion control blankets in strategic areas and revegetating the affected areas. This type of maintenance will be necessary only on the frequency of severe storm events and can be completed by the Prides Creek Park maintenance crew. Frequent maintenance of the structures generally should not be required.

Dredging of the structures will be the most intensive maintenance operation. Dredging, in most cases, will be required every ten (10) years following construction. This estimate may fluctuate depending on the storm events and erosion control practices in the watersheds.

It is expected that dredging of Construction Area No. 1 will be required only in the primary sediment trap for an extended period of time. The primary sediment trap is designed to efficiently remove the largest portion of the sediment load which will also reduce sedimentation in the storm detention area. Dredging will be required when approximately 3.5 feet of sediment has accumulated in the

primary sediment trap. The depth of accumulated sediment should be measured in the sediment trap each year during the month of March. The measurement should be taken at the same location each year.

Construction Area No. 2 will require more than dredging of the primary sediment trap. It will also be necessary to remove any accumulated sediment of significance throughout the structure. The primary sediment trap should be the indicator of when dredging is necessary. Therefore, dredging will be required in Construction Area No. 2 when the primary sediment trap has accumulated 5.0 feet of sediment. The depth of accumulated sediment should be measured in the primary sediment trap each year in the month of March. The measurement should be taken at the same location each year. Other areas in this structure should also be monitored for sediment accumulation. If the efficiency of the structure is affected by the accumulation of sediment in areas other than the primary sediment trap, the sediment should be removed from these areas. This would be done during the dredging of the primary sediment trap, removing sediments to the original construction depth by referencing the design plans.

The dredging of the structures will require that an excavation contractor be hired by the Conservancy District due to the equipment necessary to complete the work. The

dredging will entail the use of an extended arm excavator or small dragline and trucks for hauling the sediment to a disposal site.

The excavated sediment will be disposed of on-site, if possible, and utilized as fill material or topsoil for eroded areas after drying. Since the sediment is not anticipated to contain any environmentally hazardous materials, a special disposal area will not be required.

7.3 Maintenance Cost

The expected cost per year for maintenance is $1,500.00. This estimate is based on 1990 costs and includes all maintenance, i.e. dredging, riprap, erosion control blankets, and revegetation, that is anticipated for both construction areas.

8.0 PERMITS

Upon contacting the appropriate federal, state and local agencies, only a Construction in a Floodway permit is required for the recommended construction. This permit is issued by the Indiana Department of Natural Resources, Division of Water.

The Construction in a Floodway permit has been completed and sent to the Division of Water. The review period may be from sixty (60) to ninety (90) days.

9.0 CONSTRUCTION OBSERVATION PLAN

The construction observation plan is provided to aid the Engineer in identifying what should be monitored and observed during construction. The construction observation plan will also identify any specified methods, procedures, and equipment which should be used during construction by the Engineer.

The Engineer should not limit the observation to only the items described in this construction observation plan. This plan should be used in conjunction with the Technical Specifications contained in the Contract Documents.

The Engineer (or the Engineer's representative) which observes the construction of this project should have a solid background in construction engineering. The observer should have an understanding of all the monitoring required and be capable of completing all the tests and procedures described herein.

The Engineer will be responsible for producing a set of as built plans following the completion of the project as part of the construction observation.

9.1 Earthwork

9.1.1 General

The earthwork shall consist of the work described in the Contract Documents. The Engineer will be responsible for random visual examinations of the material which will be placed as embankments, bars, islands, dams, etc. in each structure (see Contract Documents).

These random examinations, conducted by the Engineer, shall be a check that the Contractor is placing the material as described in the Contract Documents. The examinations shall be completed during the placement of material.

The Engineer shall not be responsible for any construction layout and grade staking, but the Engineer shall maintain the baselines and bench marks. The Engineer should make random observations on the location of the structures to check compliance of the Contractor with Contract Documents.

Continuous monitoring is not required for this item.

9.1.2 Equipment

theodolite	engineer's level
level rod	measuring tape

9.2 Channel Reconstruction

9.2.1 General

The channel reconstruction shall consist of the work described in the Contract Documents. The Engineer will be responsible for observing the channel reconstruction completed by the Contractor. The Engineer should examine the location, grade and cross-section of the new channel to check compliance by the Contractor with the Contract Documents. It will not be the responsiblity of the Engineer to complete construction layout or grade staking.

Channel reconstruction will not require continuous monitoring by the Engineer.

9.2.2 Equipment

engineer's level	level rod
measuring tape	theodolite

9.3 Diversion Ditch

9.3.1 General

The diversion ditch construction shall consist of the work described in the Contract Documents. The Engineer

will be responsible for observing the diversion ditch construction completed by the Contractor. The Engineer should examine the location, grade and cross-section of the new ditch to check compliance by the Contractor with the Contract Documents. It will not be the responsiblity of the Engineer to complete construction layout or grade staking.

Diversion ditch construction will not require continuous monitoring by the Engineer.

9.3.2 Equipment

engineer's level level rod
measuring tape

9.4 Riprap and Geotextile Filter Fabric

9.4.1 General

This work shall consist of the description presented in the Contract Documents for riprap and geotextile filter fabric. The Engineer will be responsible for observing the placement of these items by the Contractor.

The Engineer shall require that certifications of compliance pertaining to the manufacturing of the geotextile filter fabric be given to him by the

Contractor. The certification shall include actual test results of the fabric.

The Engineer shall also collect all tickets to verify the quantity of geotextile filter fabric and riprap used.

Continuous monitoring will not be required for this item, but the Engineer shall observe that the geotextile filter fabric and riprap is placed according to the Contract Documents.

9.4.2 Equipment

measuring tape

9.5 Erosion Control Blankets

9.5.1 General

This shall include the work described in the Contract Documents for erosion control blankets. The Engineer will be required to observe the placement of the erosion control blankets by the Contractor.

The Engineer shall collect from the Contractor a certificate of compliance from the manufacturer of the erosion control blankets. The erosion control blanket shall meet the specifications given in the Contract Documents. Tickets shall also be collected by the Engineer

to verify the quantity of erosion control blankets used by the Contractor.

Continuous observation will not be required by the Engineer for this item, but the Engineer shall observe that the erosion control blanket is being placed according to the Contract Documents.

9.5.2 Equipment

measuring tape

9.6 Mulched Seeding

9.6.1 General

This shall include the work described in the Contract Documents for mulched seeding. The Engineer will be responsible to observe the work completed by the Contractor under this item.

The soil analysis conducted to determine the needed soil additives by the Contractor shall be reviewed and approved by the Engineer. The Engineer shall also collect seed certifications from the Contractor on the seed used as described in the Contract Documents and shall collect all weigh tickets on seed, mulch, lime, and fertilizer used.

Continuous monitoring is not required for mulched

seeding, but the Engineer shall observe that the mulched seeding is completed according to the Contract Documents.

9.6.2 Equipment - None required.

9.7 Culvert Installation

9.7.1 General

This work shall include all items described in the Contract Documents for culvert installation. The Engineer shall observe the culvert installation by the Contractor. The Engineer will be required to check the location, grade, and backfill of the culvert pipe before final backfilling begins. The Engineer shall be present during the backfilling operation to insure that the operation is completed properly.

The Engineer shall require that all weigh tickets and pipe material tickets be submitted to him by the Contractor to verify the quantities used.

Continuous monitoring is required for this item.

9.7.2 Equipment

measuring tape
engineer's level
level rod

9.8 Manholes

9.8.1 General

This work shall include the raising of the manhole in Construction Area No. 1 as described in the Contract Documents. The Engineer shall observe the work completed by the Contractor under this item.

Continuous monitoring is not required, but the Engineer shall observe that the manhole is raised according to the Contract Documents.

9.8.2 Equipment - None required.

9.9 Drain Pipe

9.9.1 General

The work shall include the items described in the Contract Documents for drain pipe. The Engineer shall observe this work to be completed by the Contractor.

The Engineer shall collect product data from the Contractor concerning the pipe material used.

The Engineer will not be responsible for setting the grade of the drain pipe.

This item shall include the twelve (12) inch diameter

drain pipe in Construction Area No. 1

Continuous monitoring will not be required for this item.

9.9.2 Equipment

level level rod

measuring tape

9.10 Water Pipe

9.10.1 General

This work shall consist of the items described in the Contract Documents for water pipe. The Engineer shall observe the work to be completed by the Contractor under this item.

The Engineer shall require that product data be submitted to him by the Contractor for the materials used to check compliance with the Contract Documents. The Engineer will be responsible for observing the testing and chlorination of the water pipe. This will include the determination that appropriate chlorination levels, as described in the Contract Documents, were adhered to by the Contractor.

Continuous monitoring will not be required for this item.

9.10.2 Equipment

measuring tape chlorination testing equipment

9.11 Electric Cable

9.11.1 General

The electric cable work shall consist of the items described in the Contract Documents. The Engineer shall observe the work to be completed by the Contractor.

The Engineer shall require that product data be submitted to him by the Contractor for the materials used to check compliance with Contract Documents.

Continuous monitoring will not be required for this item, but the Engineer shall observe that the electric cable is installed according to the Contract Documents.

9.11.2 Equipment

measuring tape

9.12 Trench Excavation and Backfilling

9.12.1 General

This work shall include all items described in the

Contract Documents for trench excavation and backfilling. The Engineer shall randomly observe this work which will be completed by the Contractor.

Continuous monitoring will not be required for this item.

9.12.2 Equipment

engineer's level level rod

measuring tape

10.0 POST-MONITORING PLAN

The intent of the post-monitoring plan is to evaluate the efficiency of the previously described structures in removing the suspended particulates and nutrients from storm runoff. The plan will describe the type of monitoring, monitoring locations, frequency, and monitoring methods. It will be the responsibility of the Prides Creek Conservancy District to complete the monitoring in accordance with the methods and procedures contained herein. The person, company, corporation, etc. which is directed by the Conservancy District Board to complete the monitoring should be competent in collecting and analyzing the samples.

The monitoring shall continue for a period of two (2) years following the completion of the structures. The monitoring of the structures shall consist of collecting water samples during storm events (when possible), recording storm event rainfall, recording flow through the structures, lake pool elevation, and a vegetation description. The monitoring should be conducted a minimum of once (1) per month and preferably twice (2) during the months of May through August.

Pre-construction monitoring of the existing inlet areas is preferable, but it is not required. This would enable a better estimation of structure efficiency to be determined by comparison of pre-construction to post-construction data.

All post monitoring data shall be made available by the Prides Creek Conservancy District to the Department of Natural Resources, Division of Soil Conservation for their use.

10.1 Water Sample Collection and Analysis

A water sample shall be taken at both the inlet and outlet of both structures. Samples should be collected while the structures are functioning to remove suspended particles from storm runoff. These samples shall be analyzed for total suspended solids, total phosphorus, soluble reactive phosphorus, nitrates and total kjeldahl nitrogen. The following paragraphs identify the methods that should be used for water sample collection and analysis. The collection and analysis procedures were taken from the Standard Methods for the Examination of Water and Wastewater, 17th Ed. which is endorsed by the American Water Works Association (AWWA), American Public Health Association (APHA), and the Water Pollution Control Federation (WPCF).

10.1.1 Total Suspended Solids

The samples should be collected in 125ml high density polyethylene (HDPE) bottles. The total suspended solids should be determined as described in 2540 D.

10.1.2 Total Phosphorus

The samples should be collected in 125ml acid washed glass bottles. The samples should be preserved with 1 ml conc. HCl/L and stored at $4^{o}C$ as described in 4500-P.A.5. The samples should be digested according to the Sulfuric Acid-Nitric Acid Digestion as described in 4500-P.B.4. After digestion, the samples should be quantified using the Ascorbic Acid Method as described in 4500-P.E.

10.1.3 Soluble Reactive Phosphorus

This parameter requires the most field experience. If someone is not acquainted with the techniques and the precautions that need to be taken, the samples can very easily become contaminated. The samples need to be filtered in the field. This requires using an Ehrlenmeyer side-arm flask, Buchner funnel, 0.45 micron-pore-diameter filters, tweezers and hand pump. All glassware must be rinsed with hot diluted HCl then rinsed several times with deionized distilled water. The filters must be prepared as described in 4500-P.B. The following steps should be observed during the filtration:

a) Rinse Buchner funnel with deionized (D.I.) water from wash bottle. Place funnel on side-arm flask.

b) Rinse tweezers with D.I. water and carefully pick out one filter and place it in the funnel. (Cracked or torn filters must be discarded.)

c) Carefully fill funnel 1/2 full while applying slight pressure with the hand pump. Water flow must not lift up edge of filter paper.

d) When water is filtered, release pressure and rinse side-arm flask. Discard rinse water.

e) Replace funnel and add more water, under pressure. Filter enough water to fill an acid rinsed 125 ml glass bottle (~ 100ml). DO NOT let pump pressure exceed 12 PSI and DO NOT let the funnel run dry.

f) When sufficient water is filtered, let remaining water in funnel filter through and release pump pressure only when the funnel is empty.

g) Pour small amount (5ml) of filtered sample into acid-washed bottle, replace cap, rinse and discard rinse water. Fill bottle with remaining filtered

water. DO NOT set the glass stopper down or touch the stopper or bottle lip with your fingers. With little effort, you should be able to hold the stopper head between your 3rd and 4th finger and the bottle between the thumb and index finger of the same hand. This will prevent stopper contamination.

h) Discard filter, rinse funnel with D.I. water.

The sample should be stored at 4°C and analyzed within 48 hours of collection. The samples should be quantified using the Ascorbic Acid Method as described in 4500-P.E.

10.1.4 Nitrates

The sample should be collected in 125ml high density polyethylene (HDPE) bottles. The sample should be preserved with 2ml of concentrated H_2SO_4/liter sample if they are to be stored longer than 24 hours. The samples should be stored at 4°C. The nitrates should be analyzed using either the Nitrate Electrode Method - 4500-NO_3-D, or by Ion Chromatograph - 4500-NO_3C.

10.1.5 Total Kjeldahl Nitrogen

The samples should be collected in 125ml high density polyethylene (HDPE) bottles. The samples should be acidified to a pH of 1.5 to 2.0 with concentrated H_2SO_4 and stored at 4^oC as described in 4500-Norg A.2. The samples should be digested and distilled according to the Semi-Micro-Kjeldahl Methods described in 4500-Norg C. The final ammonia determination may be done by nesslerization, manual phenate, titration, or amonia-selective electrode method as described in 4500-NH_3 C, D, E, and F.

10.1.6 Caution with Acids

Caution should be taken when conducting any of the above listed tests. Several of these tests use toxic and/or corrosive chemicals. Extra care should be exercised when working with H_2SO_4, HCl or HNO_3 as described in the above methods.

10.2 Storm Event Rainfall

The rainfall which occurs during the storm event in which the monitoring is completed should be recorded. This can be accomplished by a rain gauge on site or by contacting an authorized weather monitoring station in the

near vicinity of Prides Creek Park. The rainfall data should be recorded each time the monitoring is completed.

10.3 Flow of Runoff Through the Structures

Flow through the structures should be recorded during the collection of the water samples. This can be completed by measuring water depths at the inlets and outlets of the structures.

The flow into the structure in Construction Area No. 1 should be measured by recording the depth of water in the reconstructed channel which outlets into the structure. The measurement should be taken approximately 100 to 125 feet upstream from the mouth of the channel. The flow out of the structure should be measured by recording the depth of water at the spillway.

The flow into the structure in Construction Area No. 2 should be measured by recording the depth of water in the 58 in. X 37 in. corrugated metal pipe arch which outlets into the structure. This measurement should be taken at the outlet of the pipe arch. The flow out of the structure should be measured by recording the depth of water at the spillway.

The flow depths should be measured to the nearest tenth (10th) of a foot. Notes should be taken to verify the location, type of flow channel, flow velocity typical

dimensions, and the condition of the flow channel. The flow data should be taken in approximately the same location each time.

10.4 Pool Elevation

The pool elevation can be obtained through the Prides Creek Park manager. The elevation should be recorded to the nearest tenth (10th) of a foot. The measurement should be made and recorded each time the structures are monitored.

If the pool elevation is not made available by the Park Manager, it should be determined by setting a vertical control point in the lake. This point should be set by using the vertical control shown in the Plans.

10.5 Vegetation Description

A description of the vegetation condition should also be included in the monitoring. This will enable seasonal variations in plant life to be considered when evaluating the efficiency of the structures.

This data should include a description of both above and below water vegetation with an approximate estimate of the quantity and location within the structures. Photos may be used to aid the description.

11.0 ENGINEER'S ESTIMATE

This estimate reflects the bid items shown in the Contract Documents. The prices shown may vary depending upon the suppliers and the conditions encountered.

ESTIMATED CONSTRUCTION COSTS

AREA NO. 1

ITEM NO	ITEM	UNIT	AMOUNT	UNIT PRICE	TOTAL PRICE
01	Mobilization/ Demobilization	L.S.	1.00	2,450.00	2,450.00
02	Unclassified Excavation	C.Y.	8,560.00	3.00	25,680.00
03	Geotextile Filter Fabric	S.Y.	1,112.00	2.36	2,624.32
04	Erosion Control Blanket	S.Y.	3,570.00	1.62	5,783.40
05	Mulched Seeding	S.Y.	13,000.00	0.20	2,600.00
06	Riprap, 12 in.	Ton	380.00	25.00	9,500.00
07	Riprap, fines to 12 in.	Ton	240.00	25.00	6,000.00
08	12 in. Drain Pipe, Corrugated Polyethylene	LFT.	190.00	9.10	1,729.00
09	1 in. Water Line, PVC	LFT.	560.00	3.00	1,680.00
10	600 Volt Triplex Electric Cable, Direct Burial	LFT.	550.00	2.87	1,578.50
TOTAL ESTIMATED CONSTRUCTION COST AREA NO. 1					$59,625.22

ESTIMATED CONSTRUCTION COSTS
AREA NO. 2

ITEM NO	ITEM	UNIT	AMOUNT	UNIT PRICE	TOTAL PRICE
01	Mobilization/ Demobilization	L.S.	1.00	1,800.00	1,800.00
02	Unclassified Excavation	C.Y.	1,820.00	3.00	5,460.00
03	Geotextile Filter Fabric	S.Y.	1,351.00	2.36	3,188.36
04	Erosion Control Blanket	S.Y.	2,300.00	1.62	3,726.00
05	Mulched Seeding	S.Y.	10,100.00	0.20	2,020.00
06	Riprap, 12 in.	Ton	600.00	25.00	15,000.00
07	57 in. X 38 in. C.M.P.A. Aluminized	LFT.	70.00	85.00	5,950.00
TOTAL ESTIMATED CONSTRUCTION COST AREA NO. 2					$37,144.36

11.2 Contingency Items

These contingency items were separated from the other construction items because it was the opinion of the Lake Enhancement staff, Indiana Division of Soil Conservation, that the items shown would most likely not be funded by the Division of Soil Conservation. Therefore, by including them as contingency items, they can remain in the project and be funded solely by the Prides Creek Conservancy District, if the Division of Soil Conservation does not feel they are appropriate items.

ITEM	UNIT	AMOUNT	UNIT PRICE	TOTAL PRICE
Project Sign	L.S.	1.00	130.00	130.00
Diversion Ditch	LFT.	400.00	5.25	2,100.00
TOTAL OF CONTINGENCY PRICES				$2,230.00

11.3 Estimated Construction Observation Cost

The estimated cost for a consulting engineering firm to provide construction observation services for the project, as it is described in this design report, is $7,500.00

11.4 Total Estimated Project Cost

The total estimated cost of this project, including construction and construction observation costs, is $106,499.58.

REFERENCES

American Iron and Steel Institute. 1983. Handbook of Steel Drainage & Highway Construction Projects, Third Edition. Washington, D.C., American Iron and Steel Institute.

American Public Health Association (APHA), American Water Works Association (AWWA), and the Water Pollution Control Federation (WPCF). 1989. Standard Methods for the Examination of Water and Wastewater, Seventeenth Edition. Washington D.C., APHA, AWWA, and WPCF.

Barfield B.J. and C.T. Haan. 1978. Hydrology and Sedimentology of Surface Mined Lands. Lexington, Kentucky, University of Kentucky.

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Barfield B.J., R.C. Warner and C.T. Haan. 1981. Allied Hydrology and Sedimentology for Disturbed Areas. Stillwater, Oklahoma, Oklahoma Technical Press.

Indiana Department of Natural Resources, Division of Water. 1981. Rainfall Frequency for Indiana. Indianapolis, Indiana, Indiana Department of Natural Resources.

United States Department of Agriculture, Soil Conservation Service. 1984. Engineering Field Manual, Fourth Edition. Washington, D.C., Soil Conservation Service.

APPENDIX A

WATERSHED MAP

Map is not included in electronic copy of this document.

APPENDIX B

DESIGN DATA

BASIN AREA NO. 1

SEDIMENT CONTROL STRUCTURE DESIGN

PRIDES CREEK CONS. DIST.

PETERSBURG, INDIANA

STRUCTURE -1

WATERSHED -PRIDES CREEK

COUNTY -PIKE

STRUCTURE LOCATION - SEE PLANS

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WATERSHED DATA

TOTAL DRAINAGE ABOVE STRUCTURE..... 87.64

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SEDIMENT VOLUME

DISTURBED AREA	AREA DISTURBED	ACRE FEET PER ACRE	ACRE FEET
ENTIRE WATERSHED	87.64	0.01	0.9
		TOTAL	0.89

DRAINAGE CHARACTERISTICS

LAND USE	HYDROLOGIC COND	GRP	RCN	ACRS	RCN X ACRS
FOREST	FAIR	C	70	37.8	2646
GRASSLAND	FAIR	C	79	24.9	1967
CROPLAND	FAIR	C	84	21.3	1789
RESIDENTIAL	FAIR	C	85	3.7	315
		TOTAL		87.7	6717

WEIGHTED RCN= 77.

STORM RETENTION FOR 10 YEAR 24 HOUR STORM 6 HOUR DETENTION

TOTAL RAINFALL - 4.6 INCHES

HIGHEST RCN - 77

TOTAL 24 HOUR STORM RUNOFF 2.3 INCHES

TOTAL 6 HOUR STORM RUNOFF VOLUME 4.1 ACRE FT.
TOTAL REQUIRED STORAGE 5.0 ACRE FEET

ELEV (FT)	AREA (AC)	AV. AREA (AC)	INTERVAL (FT)	STORAGE (AC FT)	ACCUMULATED ACRE FEET
464	0.19				0.00
		0.24	2	0.48	
466	0.29				0.48
		0.49	2	0.98	
468	0.69				1.46
		0.73	2	1.45	
470	0.76				2.91
		0.86	4	3.42	
474	0.95				6.33
		1.03	4	4.14	
478	1.12				10.47
		1.54	2	3.07	
480	1.95				13.54
		2.22	3	6.67	
483	2.50				20.21

EXISTING SPILLWAY ELEVATION 472.5
STORAGE = 5.0 ACRE FEET

OUTFLOW CHARACTERISTICS --- WITH THE MAXIMUM RCN OF 77

5 YEAR STORM --- TOTAL RAINFALL 5.25 INCHES --- LAND SLOPE 3 %
LONGEST WATER PATH 2300 FEET
WITH AN OPEN CHANNEL SPILLWAY WIDTH OF 9.75 FEET

TAGE ABOVE PRIN. SPILL. (FT.)	STORAGE (AC.FT.)	DISCHARGE (CFS)
0	5.0	0
1	5.9	30
2	6.8	84
3	7.9	154
4	8.9	236

INFLOW-OUTFLOW HYDROGRAPH

TIME MIN	INFLOW CFS	HP FT	OUTFLOW CFS	
5	0	0.0	0	
10	0	0.0	0	
15	1	0.0	0	
20	2	0.0	0	
25	4	0.0	1	
30	7	0.1	2	
35	10	0.1	4	
40	13	0.2	5	
45	20	0.3	8	
50	31	0.4	11	
55	47	0.6	17	
60	68	0.9	26	
65	94	1.2	42	
70	121	1.6	64	
75	140	2.0	86	
80	152	2.4	109	
85	154	2.6	125	
90	148	2.7	135	
95	132	2.8	137	
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100	115	2.7	132	
105	98	2.6	122	
110	79	2.4	110	
115	64	2.2	95	
120	51	2.0	82	
125	41	1.7	70	
130	34	1.5	59	
135	30	1.4	50	
140	29	1.3	43	
145	25	1.2	38	

NOTE: HP IS HEIGHTH ABOVE HIGHEST SPILLWAY

Table 3:1. The Classification of Soil Particles According to Two Systems[a] (U.S. and International) and the Mechanical Analyses of Two Soils Using the U.S. System

	United States Department of Agriculture System			International System
Soil Separate	*Diameter Limits (mm)*	*Analyses of Two Typical Soils* *sandy loam (Percentage)*	*clay loam (Percentage)*	*Diameter Limits (mm)*
Very coarse sand	2.00–1.00	3.1	2.2	
Coarse sand	1.00–0.50	10.5	4.0	2.00–0.20
Medium sand	0.50–0.25	8.2	6.3	
Fine sand	0.25–0.10	25.3	8.4	0.20–0.02
Very fine sand	0.10–0.05	22.0	9.6	
Silt	0.50–0.002	21.1	37.2	0.02–0.002
Clay	below 0.002	9.8	32.3	below 0.002

[a] From *Soil Survey Manual* (U.S. Dept. of Agriculture Handbook No. 18, 1951), p. 207.

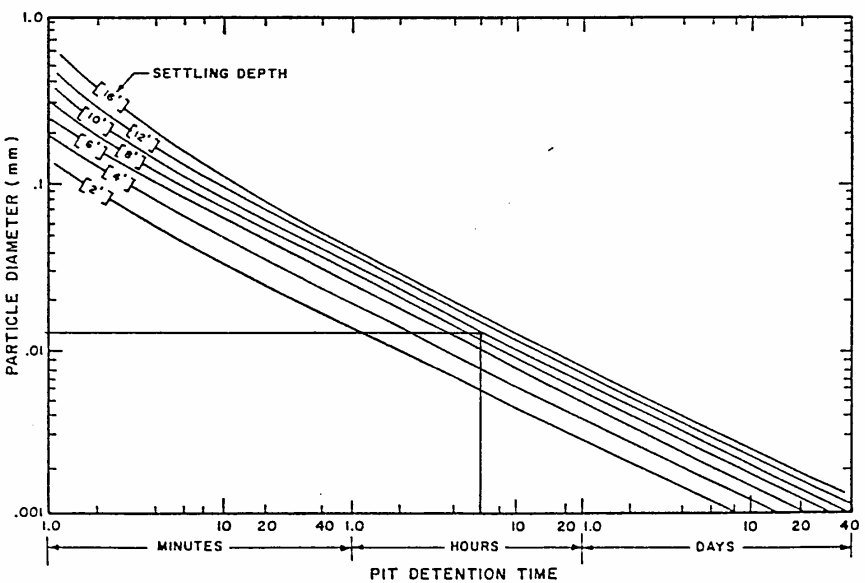

Figure 5.25. Pit detention time.

BASIN AREA NO. 2

SEDIMENT CONTROL STRUCTURE DESIGN

PRIDES CREEK CONS. DIST.

PETERSBURG, INDIANA

STRUCTURE -2

WATERSHED -PRIDES CREEK

COUNTY -PIKE

STRUCTURE LOCATION - SEE PLANS

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****

WATERSHED DATA

TOTAL DRAINAGE ABOVE STRUCTURE..... 50.90

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SEDIMENT VOLUME

DISTURBED AREA	AREA DISTURBED	ACRE FEET PER ACRE	ACRE FEET
ENTIRE WATERSHED	50.90	0.01	0.6
		TOTAL	0.57

DRAINAGE CHARACTERISTICS

LAND USE	HYDROLOGIC COND	GRP	RCN	ACRS	RCN X ACRS
*FOREST	FAIR	C	70	19.1	1337
*GRASSLAND	FAIR	C	79	12.7	1003
*CROPLAND	FAIR	C	84	16.7	1403
*RESIDENTIAL	FAIR	C	85	2.4	204
		TOTAL		50.9	3947

WEIGHTED RCN= 78.

STORM RETENTION FOR 10 YEAR 24 HOUR STORM 4 HOUR DETENTION

TOTAL RAINFALL - 4.6 INCHES

HIGHEST RCN - 78

TOTAL 24 HOUR STORM RUNOFF 2.3 INCHES

TOTAL 4 HOUR STORM RUNOFF VOLUME 1.7 ACRE FT.
TOTAL REQUIRED STORAGE 2.2 ACRE FEET

ELEV (FT)	AREA (AC)	AV. AREA (AC)	INTERVAL (FT)	STORAGE (AC FT)	ACCUMULATED ACRE FEET
463	0.02				0.00
		0.06	4	0.26	
467	0.11				0.26
		0.13	3	0.40	
470	0.16				0.66
		0.26	3	0.78	
473	0.36				1.44
		0.39	2	0.78	
475	0.42				2.22
		0.71	10	7.10	
485	1.00				9.32

SPILLWAY ELEVATION 475.0
STORAGE = 2.2 ACRE FEET

OUTFLOW CHARACTERISTICS --- WITH THE MAXIMUM RCN OF 78

25 YEAR STORM --- TOTAL RAINFALL 5.25 INCHES --- LAND SLOPE 2 %
LONGEST WATER PATH 1800 FEET
WITH AN OPEN CHANNEL SPILLWAY WIDTH OF 15 FEET

STAGE ABOVE PRIN. SPILL. (FT.)	STORAGE (AC.FT.)	DISCHARGE (CFS)
0	2.2	0
1	2.9	45
2	3.6	129

INFLOW-OUTFLOW HYDROGRAPH

TIME MIN	INFLOW CFS	HP FT	OUTFLOW CFS	
5	0	0.0	0	
10	0	0.0	0	
15	1	0.0	0	
20	2	0.0	0	
25	3	0.0	1	
30	5	0.0	2	
35	6	0.1	3	
40	8	0.1	5	
45	12	0.1	7	
50	19	0.2	10	
55	28	0.3	15	
60	41	0.5	22	
65	57	0.7	32	
70	73	1.0	44	
75	84	1.2	63	
80	91	1.4	77	
85	93	1.5	86	
90	89	1.5	88	
----------	----------	----------	----------	Q MAX
95	79	1.5	86	
100	69	1.4	79	
105	58	1.3	70	
110	47	1.2	60	
115	38	1.1	50	
120	31	0.9	43	
125	24	0.8	37	
130	20	0.7	32	
135	18	0.6	27	
140	17	0.5	24	
145	15	0.5	21	

NOTE: HP IS HEIGHTH ABOVE HIGHEST SPILLWAY

Table 3:1. The Classification of Soil Particles According to Two Systems[a] (U.S. and International) and the Mechanical Analyses of Two Soils Using the U.S. System

	United States Department of Agriculture System			International System
Soil Separate	*Diameter Limits (mm)*	*Analyses of Two Typical Soils sandy loam (Percentage)*	*clay loam (Percentage)*	*Diameter Limits (mm)*
Very coarse sand	2.00–1.00	3.1	2.2	
Coarse sand	1.00–0.50	10.5	4.0	2.00–0.20
Medium sand	0.50–0.25	8.2	6.3	
Fine sand	0.25–0.10	25.3	8.4	0.20–0.02
Very fine sand	0.10–0.05	22.0	9.6	
Silt	0.50–0.002	21.1	37.2	0.02–0.002
Clay	below 0.002	9.8	32.3	below 0.002

[a] From *Soil Survey Manual* (U.S. Dept. of Agriculture Handbook No. 18, 1951), p. 207.

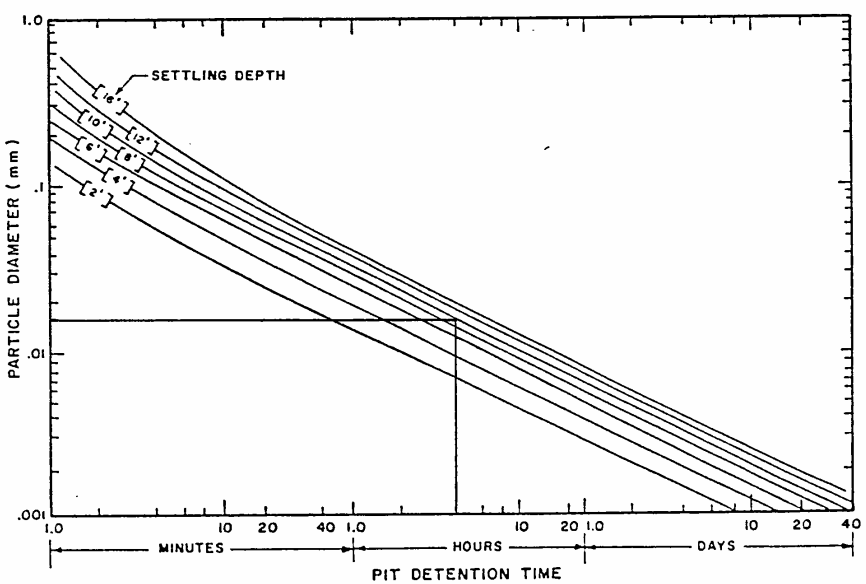

Figure 5.25. Pit detention time.

APPENDIX C

SOIL ANALYSIS DATA

TABULATION OF LABORATORY TESTS
Prides Creek Lake Enchantment

BORING NUMBER	Grain Size Distribution			Moisture (%)	Atterberg Limits					Proctors	
	Clay (%)	Silt (%)	Sand & Gravel (%)		LL	PL	PI	AASHTO	Unified	Max. Dry Density (pcf)	Opt. Moisture Content (%)
B-1-1	22	70	8	33.7	31	21	10	A-4	CL	106.2	17.3
B-1-2	32	66	2	23.0	43	22	21	A-7-6	CL	102.5	19.8
B-2-1	15	74	11	17.5	25	20	5	A-4	CL-ML	108.8	16.0
B-2-2	23	71	6	31.4	31	21	10	A-4	CL	110.5	15.5